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(71) Applicant *(for all designated States except US)*: LIFE SCIENCE TGO, S.R.L. [BB/BB]; Chancery House, High Street, Bridgetown (BB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: CORDICK, Rae, Anne [CA/CA]; 22 St. Philips Road, Etobicoke, Ontario M9P 2N6 (CA). FREDENBURGH, Jeffrey, Kent [CA/CA]; 5054 Cherry Street, Ballantrae, R.R. #3, Stouffville, Ontario L4A 7X4 (CA).

(74) Agents: JOHNSON, Douglas, S. et al.; Dennison Associates, Suite 301, 133 Richmond Street West, Toronto, Ontario M5H 2L7 (CA).

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(57) Abstract

The present invention provides in one aspect for a method for controlling odor associated with spills of organic material which can cause odors on carpets. The method comprises applying to the carpet a preparation of dormant bacteria, which when activated are effective to control odors. The dormant bacterial preparation is allowed to become associated with the carpet, such that when the carpet is exposed to organic material which can cause odors, the bacteria are capable of becoming active and digesting the organic material.

A

Scanning Electronic Microscopic
- No Bacteria Added

B

Scanning Electronic Microscopic Results
Fiber with Bacteria Spore Blend

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BACTERIA AS ODOR CONTROL AGENT FOR CARPETS

FIELD OF THE INVENTION

The present invention is directed to a method of controlling odor associated with deposits, particularly spills of organic material on carpet or other fibrous material and to an odor control agent for use in the method. The odor control agent can be applied to the carpet or other fibrous material at various stages during manufacture or use and the effect of the odor control agent is long lasting.

BACKGROUND OF THE INVENTION

Carpet is used extensively in residential and commercial buildings as it is a relatively inexpensive and easy to install floor covering material. Carpet offers a number of desirable qualities including durability, aesthetics, comfort, safety, warmth and quietness. With modern manufacturing and dyeing techniques, carpeting may also be provided in almost any color, texture and pattern. Carpet may be manufactured from diverse types of materials including natural materials such as wool or cotton or synthetic materials from various polymers such as polypropylene, polyamide, etc. The majority of carpet, particularly for residential and commercial use, is manufactured from synthetic polymer material with polypropylene and polyamide, most commonly nylon 6 or nylon 66. Irrespective of the material used in the manufacture, the fibers are used in the form of continuous filament yarns, and in various forms as cut fiber or staple fiber. One conventional manufacturing process involves inserting plied yarn into a primary backing of jute or polypropylene fibers, dyeing the fibers and then applying a carpet backing adhesive such as latex which is adhered to a secondary backing material.

Many carpet fibers, such as polypropylene and wool, and particularly nylon may be susceptible to staining especially from the many food dyes used in beverages and other foods as well as from other chemicals from many sources. Nylon carpet fibers are often treated with stain blockers such as sulfonated phenol formaldehyde condensate polymer, a sulfonated naphthol formaldehyde condensate polymer, a hydrolyzed vinyl aromatic maleic anhydride polymer or combinations thereof. The stain blockers act to prevent or reduce the ability of organic dyes, particularly acid dye colorants from chemically reacting with and bonding to the nylon. The carpets are also commonly coated with a fluorochemical anti-soiling agent to improve the anti-staining or anti-soiling characteristics of the carpet surface. The fluorochemicals reduce the tendency of soil to adhere to the fiber making the clean-up of any spills or soil on the carpet easier. The fluorochemicals also reduce fiber wettability, making for easy clean up of liquid spills through a simple process of blotting the spill. Examples of such fluorochemicals and other stain resistant chemicals are given, for example, in U.S. Patent numbers 4,680,212 and 4,925,707, the disclosures of which are incorporated herein by reference. The use of the stain blockers and fluorochemicals may not provide complete stain resistance to the carpet, as some materials may still penetrate the nylon fibers or react with the fibers, especially if left in contact with the carpet for extended periods of time. This may be especially true where the carpet is exposed to conditions such as direct sunlight or other UV sources or high traffic areas, as these conditions may cause the effectiveness of the fluorochemical and stain blocker coatings to be diminished.

In addition, especially in residential locations, the possibility of deposits of organic matter such as feces or urine from babies and pets can result in not only soiling of the carpet but also a lingering odor and may, in extreme cases, require the replacement of the carpet. In

the past, various chemical compounds have been proposed to aid in removing odor in a cleaning process. Such chemicals generally act as odor inhibiting agents although U.S. Patent No. 4,946,672 describes the use of biguanidine polymer compositions as odor inhibiting agents. However, even in those cases where the deposit is cleaned up and odor inhibiting agents utilized, the odor from such deposits may remain in the carpet and may become apparent as the effect of the odor masking agents wear off.

Deposits of various materials on carpet may also give rise to other concerns. Many of the deposit materials are capable of supporting bacterial growth, especially in the case of feces which contains many bacteria. Some of the bacteria that may grow, as a result of a deposit, may have the potential of causing disease in persons exposed to them, such as mold and mildew. Carpet and other fibrous material are also known to contain a number of naturally occurring bacteria and other organisms. Some of these baccteria may themselves give rise to odor due to incomplete digestion of organic material. There have been attempts to reduce the presence and number of bacteria present in carpet by utilizing various anti-microbial agents such as described in U.S. Patent Nos. 4,110,504 and 5,024,840. These agents are applied to carpet in a manner similar to the way stain blockers are applied to carpet. The use of anti-microbials, while reducing the number of bacteria associated with carpet, may raise other concerns such as the potential that some of the bacteria may become resistant to effects of the anti-microbials.

Many bacterial and fungal genera are known for use in odor control due to their capability for producing enzymes which are capable of breaking down organic material. Such bacteria are particularly useful where the organic material, if allowed to remain, will give rise to malodors. Several such bacterial and fungal genera such as Bacillus, Lactobacillus, Enterobacter, Streptococcus,

Rhizopus, Nitrosomonas, Nitrobacter, Pseudomonas, Alcaligens and Klebsiella, among others, are known for use in such applications with Bacillus sp. being the most prevalent in use in various applications.

For example, European Patent Application No. 732,396 describes the use of Bacillus sp. for odor control of feedstuffs used in farming and JP Patent Application No. 7-031,668 describes their use for odor control of toilets, shoe boxes and pet litter. Other uses of the Bacillus for odor control for baby diapers and wall paper are described in JP Patent Application Nos. 2-121,665 and 3-059,199 respectively. Preparations of active Bacillus in a vegetative form suitable for spraying or otherwise distributing on a deposit, especially of pet urine and feces, on a carpet for controlling odor are presently marketed by The Bramton Company of Dallas, Texas under the trademark OUTRIGHT. The bacterial preparations are used to deodorize a deposit by application directly on the deposit. Once the deposit is deodorized, the bacteria are depleted from the site or disposed of along with the deodorized material. In the event of a new deposit on the carpet, the treatment must be repeated. In all of these circumstances, the Bacillus or other strains of bacteria are used in an active or vegetative state as fully developed bacterial cells capable of immediate growth. It has been thought in the art that the bacteria must be in the active state to be effective, and that dormant or sporulated bacterial forms are ineffective.

There thus remains a need for a means for treating carpet and other fibrous material to counteract the effects of deposits and especially for controlling odor associated with the deposits, particularly diposited organic material, where the effects of the odor control are preventative and long lasting.

SUMMARY OF THE INVENTION

The present invention provides in one aspect for a method for controlling odor associated with deposits of organic odor causing material on carpets and other fibrous materials. The method comprises applying to the carpet or other fibrous material, a preparation of dormant bacteria, which, when activated, is effective to control odors. The dormant bacterial preparation is allowed to become associated with the carpet or other fibrous material, such that when the carpet or other fibrous material is exposed to organic material which can cause odors, the bacteria are capable of becoming active and digesting the organic material.

In another aspect of the invention there is provided a composition for treating a fabric or fibrous material to provide control of odor associated with deposits of organic odor causing material on the fabric or fibrous material. The composition comprises one or more strains of dormant bacteria, which when activated are effective to control odors.

In yet another aspect of the invention there is provided an aqueous odor controlling bacterial composition for treating carpet or fabric to impart odor control. The composition comprises a stain blocker chemical and an effective amount of odor controlling bacteria.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are shown in the drawings, wherein:

Figure 1 illustrates scanning electron microscope pictures of carpet fibers containing no innoculum (Fig. 1A) and carpet fibers inoculated with a preferred bacterial spore blend prepared according to Example 1 of the present invention (Fig 1B);

Figure 2 is a graph illustrating the germination and growth of the bacteria spore blend on various organic soils;

Figure 3 is a graph illustrating the germination and growth of the bacterial spore blend in nylon carpet containing various organic soils; and

Figure 4 is a graph illustrating the germination and growth of the bacterial spore blend on carpet containing a combination of fox urine and dog feces.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is directed in one aspect to a method of controlling odor associated with deposits, particularly spills, of organic material which can cause odors on carpet or other fibrous materials. The present invention is also directed to the compositions useful for preparing carpet or other fibrous material to make them capable of controlling odor as well as to the carpet or other fibrous material so prepared. In addition to controlling odor, the compositions may also aid in reducing the staining effects of organic material.

Many bacterial genera are known to produce enzymes which are capable of breaking down organic material. Such bacteria are particularly useful where the organic material, if allowed to remain, will give rise to malodors. Several such bacterial genera such as Bacillus, Lactobacillus, Enterobacter, Streptococcus, Nitrosomonas, Nitrobacter, Pseudomonas, Alcaligens and Klebsiella amongst others are known for use in such applications, with Bacillus and Lactobacillus sp. being the most prevalent in use in various applications. Strains of bacteria from any of the above noted genera are useful in practicing the present invention. Preferably, the bacterial preparation for use in the present invention is one or more strains of Bacillus or Lactobacillus. More preferably, the strains of bacteria for use in the present invention are selected from Bacillus licheniformis, Bacillus pasteurii, Bacillus laevolacticus and Bacillus amyloliquefaciens. Each of these species have characteristics which make them most effective against particular types of organic materials.

All of these species are capable of enhanced anaerobic and aerobic growth. Bacillus pasteurii is known for superior lipase production, while Bacillus laevolacticus has a very fast germination cycle. Bacillus amyloliquefaciens is high in production of protease enzymes.

The selection of the strains of bacteria for use in the present invention may depend upon many factors. One such factor is the nature of the organic material most commonly expected for the particular application. For example, in a commercial application, the most commonly expected deposits would be soil tracked in from out-of-doors, beverages such as coffee, tea, other food and the like, especially in a restaurant environment, and possibly, inks or toners for printers and other office equipment. Many of these materials are high in fatty components so the bacterial preparation may be enhanced for strains having high activity against such materials. One example of such a bacteria is Bacillus pasteurii known for superior lipase production. In a residential environment, the nature of the deposits may differ with out-of-doors soils. For example, beverages, food and urine and feces from pets and children being most commonly encountered. Depending upon the nature of the deposited material, the preparation may be selected to contain strains having enhanced activity against such materials. Another factor which may affect the nature of the deposit is the geographical location of the installed carpet. This factor would especially relate to the nature of deposits of out-of-doors soil and to the nature of food deposits. Different regions are known to have different soil types and different regions may also have differences in the foods commonly consumed due to cultural and environmental factors. In addition, the temperature of the carpet to be treated will influence the activity of the bacteria. Depending on the strain selected the bacteria will tend to exhibit enhanced activity at higher temperatures. At lower ambient temperatures, more active strains may be desired.

The bacterial preparation will typically comprise one or more strains selected from the genera and species described above. When utilizing a mixture of more than one strain, each of the individual strains may comprise between 3% and 97% of the total of the bacteria present in the preparation. Depending upon the bacteria, these percentages are based on the total cell number or colony forming units or the total mass of the bacterial preparation. For the Bacillus sp. the percentages are based on total cell number. Preferably, each of the strains is present in sufficient numbers to make up 10% to 70% of the total bacteria in the preparation. When mixtures of more than two strains are employed, each of the strains is preferably present in an amount of from 20% to 40% of the total bacteria in the preparation. Particularly preferred preparations for general use in almost all applications are as follows:

	% of total bacteria	
Species	Range	Preferred
Bacillus licheniformis	20-60	40
Bacillus pasteurii	10-30	20
Bacillus laevolacticus	10-30	20
Bacillus amyloliquefaciens	10-30	20

In a preferred embodiment of the present invention an effective amount of a bacterial composition comprising one or more strains selected from the group consisting of Bacillus licheniformis, Bacillus pasteurii, Bacillus laevolacticus and Bacillus amyloliquefaciens and combinations thereof are provided in a state in which the composition may be applied to a carpet fiber or other fibrous material. The effective amount is a sufficient number of bacteria to provide a relatively uniform coverage of the fiber such that when any portion of the carpet is exposed to a deposit of an odor causing organic material,

the bacteria will undergo rapid growth and consume the odor causing material. The factors which can affect the number of bacteria to be used relate in most part to the nature of the carpet material. Such factors include the nature of the fiber in terms of the material, e.g. nylon or polypropylene and the like, the characteristics of the yarn in the terms of the denier and number of filaments and the characteristics of the fiber in terms of the number of yarns and the twist. These factors relate to the nature of the carpet in terms of the weight (oz) and height of the pile. All of these factors will affect the amount of exposed surface of the fibers which might be covered by the bacterial preparation. For most applications on carpet, between about 10^6 and 10^8 cells per gram of carpet fiber having a weight between about 20oz and 40oz is most effective with 10^7 cells per gram of carpet fiber being most preferred.

The preparations may be provided as a simple aqueous preparation of a suspension of the Bacillus species in a suitable aqueous carrier, such as in distilled water, tap water, a saline solution or other such aqueous solutions. Preferably, the aqueous composition comprises the odor controlling dormant bacterial strain or strains and an effective amount of a stain blocker. The stain blocker is preferably selected from the group consisting of sulfonated phenol formaldehyde condensate polymer, a sulfonated naphthol formaldehyde condensate polymer, a hydrolyzed vinyl aromatic maleic anhydride polymer or combinations thereof. The aqueous composition may also include one or more fluorochemicals typically utilized for carpet treatment, either on their own or in combination with the stain blocker. Examples of such fluorochemicals include products sold under the trademarks STAINMASTER, STAINMASTER with TEFLON, and ZONYL by DuPont and SCOTCHGARD by 3M.

The selection of the suitable fluorochemicals and stainblocker is well within the knowledge of those of skill in the art. Preferably, the fluorochemicals and stainblockers selected are soluble in water, particularly when the composition is to be used on installed carpet. When utilized during the manufacture of the carpet material, the fluorochemicals and stainblocker may be non-water soluble, provided as a dispersant preparation in which the elevated temperatures during the manufacturing process are used to bind the fluorochemicals and stainblocker to the carpet fiber and affix or attach the bacteria in the process. The use of the stain blocker and/or fluorochemical in the preparation improves the ability of the spores to become associated with the fibers. This provides increased protection of the bacteria from subsequent removal by vacuuming the possible adverse effects of environmental factors. The stain blocker and/or fluorochemical are thought to provide a protective encapsulation of the bacteria to aid in the protection of the bacteria from exposure to potentially harmful conditions such as traffic or the effects of cleaning.

The amount of the stain blocker and/or fluorochemical used in the preparations of the present invention are the amounts typically employed in the carpet and fabric industry and would be well known to those skilled in the art. Ordinarily, depending upon the nature of the stain blocker or fluorochemical and the material being treated and its location, the agents are applied to the material in an amount to result in a treatment rate of about 0.1 wt% to about 20 wt% based upon the weight of the nylon or other fibrous material being treated and the amount of stain blocker and/or fluorochemical. Commonly, the treatment rate will be from about 0.15 wt% to about 10 wt%, preferably from about 0.2 wt% to about 4 wt%, more preferably from about 0.25 wt% to about 2 wt%. Most preferably, the stain blocker or fluorochemical are applied to give a treat rate of about 0.25 wt% to 1.0 wt% based

upon the weight of the nylon or other fibrous material being treated.

When used in combination with the stain blocker and/or fluorochemical, the Bacillus species may be provided as active cells. The term "active cells" is intended to encompass cells which are in a vegetative form and are capable of immediate growth when exposed to food sources usually utilized by the bacteria. The term "dormant cells" is intended to encompass cells which are in a state which are required to be activated before they can undergo growth. One example of a dormant cell is a sporulated form of the bacteria where the spores must undergo activation and germination before growth of the bacteria can occur.

As noted above, due to the protective effects of the stain blocker and/or fluorochemical, the active bacteria would be protected from the possible effects of environmental factors. If the bacteria are provided in an active form, it is thought that they may become dormant after the application by undergoing sporulation until a deposit of organic material is encountered. In a preferred embodiment, the bacteria are provided in an already dormant or sporulated form. By providing the bacteria in a dormant or sporulated form, the bacteria are further protected from environmental factors which may prove detrimental to active bacterial cells. These environmental factors may include low moisture or humidity, as the carpet or other fibrous material would generally be kept in a dry state. Other factors may include exposure to heat, chemical agents, UV radiation from sunlight as well as the exposure to air for those strains which may be predominantly anaerobic.

The sporulated or dormant strains of bacteria become activated and undergo germination in response to being exposed to organic material including organic material which can cause odors. The factors which promote the activation of the dormant or sporulated bacteria

include the moisture and various organic compounds present in the deposit of organic material. Once activated, the bacteria undergo growth and replication, consuming the organic material in the deposit until the material is consumed. After the material is consumed, the bacteria will then become dormant by undergoing sporulation to await exposure to another deposit of organic material. It is thought that the bacteria will also be somewhat cannibalistic, in that as the bacteria break down after the depletion of the organic material, the degradation products of the break down would be utilized as a food source by other of the bacteria. Once the potential energy source is reduced and the number of bacteria is also reduced, it is thought that the remaining bacteria undergo sporulation to return to a dormant state.

The bacterial preparation may be provided as a concentrate to be diluted with the stain blocker and/or fluorochemical formulation prior to application. If provided as a concentrate, the concentrate may include other agents for improving viability of the bacterial preparation. The concentrate preferably contains between 10 and 20 times the number of cells or spores per ml of the final preparation. To prepare the final preparation 5% to 10% by volume of the concentrate is mixed with 90% to 95% by volume of the stain blocker and/or fluorochemical formulation. Thus, each ml of the concentrate is mixed with 10 to 20 ml of the stain blocker and/or fluorochemical formulation to prepare the bacterial preparation for application to carpet and other fibrous material.

When treating carpet, the aqueous odor controlling bacterial composition may be applied to the carpet at any stage during its manufacture. For example, the composition may be utilized to treat the precursor filaments, yarns or fibers prior to their use in the conventional manufacturing process. The filament or yarn may be run through a bath containing the aqueous solution of the bacterial

preparation or the bacterial preparation may be sprayed on the filament. After the treatment, the filaments or yarns are dried and then further processed into carpet in the normal manner. Alternatively, the carpet during the manufacturing process may be immersed, sprayed or otherwise treated with the aqueous composition. The carpet fibers may be sprayed or otherwise treated with the bacterial preparation prior to being inserted into the primary backing. Alternatively, the fibers may also be treated once they have been inserted into the primary backing, either before or after the backing adhesive and secondary backing material have been applied. The composition may also be applied to the finished carpet as a final step prior to drying and rolling. The carpet would be sprayed or otherwise treated with the aqueous bacterial preparation, after which time the carpet would be dried in the usual manner and rolled onto the roll.

Another option would be to apply the composition to an installed carpet. When applying the composition to an installed carpet, it is preferred that the composition be applied thoroughly and evenly throughout the length of the pile, especially reaching down to the base of the pile fiber. This is generally achieved by applying the aqueous bacterial preparation to the carpet and then working the fibers to improve the contact, distribution and penetration of the bacterial preparation. This is most commonly achieved by use of a pile brush operated either by hand or automatically for example, utilizing a cleaning device such as is commonly available commercially. To enhance the penetration of the bacterial preparation, the fibers of the carpet may initially be wetted through an application of a detergent solution. This is most commonly applied where the installed carpet is cleaned using a cleaning machine prior to the application of the bacterial preparation. While the carpet fibers are still moist, the bacterial preparation may be applied and worked into the carpet, utilizing the pile brush. Once the carpet has been so

treated, it is dried, either by allowing it to dry in the air at ambient temperature or through the use of hot air blown through the pile of the carpet to increase the speed of drying of the carpet. Depending upon the state of the carpet or other fibrous material, the composition may be applied in many different ways. The composition may be applied by dipping the material in the composition or by spraying the composition onto the fibrous material. In any of these cases, once the fiber or carpet is treated with the composition, the treated carpet material is allowed to dry by way of applied heat or simply by ambient drying. Alternatively, or in addition to treating the carpet fiber with the aqueous composition, the carpet backing and/or carpet cushion underlayment may also be treated with the bacterial preparation. Once again, the carpet backing and/or carpet cushion underlayment may be treated during the manufacturing process, or prior to its installation. The carpet cushion underlayment may also be similarly treated during the installation of the carpet cushion underlayment.

The following examples illustrate the use of the present invention but are not to be construed as limiting the scope of the present invention.

Example 1

A known weight of carpet was conditioned at 50% humidity at 75°F. After conditioning, the carpet was sprayed with a suspension of a mixture of sporulated forms of Bacillus sp. having the following formulation:

Species	% of total bacteria
Bacillus licheniformis	40
Bacillus pasteurii	20
Bacillus laevolacticus	20
Bacillus amyloliquefaciens	20

The bacterial suspension was prepared in an aqueous solution of 5% ZONYL 7044 fluorochemical in distilled water at a concentration of 10^8 spores per ml. The bacterial suspension was applied to the carpet in an aerosol form to provide a treatment rate of 10^7 spores per gram of carpet. After the application of the bacterial suspension, the carpet was dried at 290°F in an oven in a humidity controlled chamber for 20 minutes. A sample of the carpet fiber treated with the bacterial suspension was compared with a sample of untreated carpet fiber by scanning electron microscopy. The results of this comparison are shown in Figure 1 where Figure 1a illustrates the carpet fiber containing naturally occurring bacteria and other microorganisms adhered to the carpet fiber which was not treated. Figure 1b illustrates a carpet fiber inoculated with the bacterial spore preparation. As can be seen in the micrographs, the treated carpet fiber has a large number of Bacillus spores adhered to the surface of the fiber with very little, if any naturally occurring bacteria or other microorganisms present in the sample.

Example 2

Samples of carpet fiber and plate count broth were examined for oxygen uptake using a standard respirometric study. Oxygen uptake is commonly utilized in those applications where it is not possible to easily measure bacterial growth by other methods. It is known that for aerobic bacteria, oxygen uptake is directly proportional to bacteria count, with the greater the uptake, the higher the corresponding bacteria count would be. The respirometric studies were conducted using a Challenge AER100 respirometer with all samples incubated under controlled temperature conditions. The treatment reactors were 500 ml bottles with CO_2 adsorption trap inserts containing 5 ml of 30% KOH (w/v) with alizarin yellow pH indicator. The sterilized traps were filled with the KOH caustic solution then inserted into the sterilized reactors using aseptic techniques. The CO_2 traps also contained sterilized

medical cotton rolls used as wicks to increase the surface area of the caustic solution. Each reactor was provided with sufficient carpet material to yield 5 grams of carpet fiber. A plate count broth prepared by mixing 17g Difco Plate Count Broth, 0.073g KH_2PO_4, 0.114g K_2HPO_4 per liter of distilled water and the pH adjusted to 7 was added to the reactor and the reactors autoclaved to sterilize them. The reactors were allowed to cool and 0.5 ml of the bacterial suspension utilized in Example 1 containing 10^8 spores per ml were added to the test reactors. The same volume of distilled water was added to the control reactors. The reactors were capped without the caustic traps and rolled and swirled to ensure that the water and bacterial preparations were mixed well with the organic materials and to permit the carpet to absorb the liquid. The caustic traps were then inserted into the reactors and the reactors hooked up to the respirometer systems. The reactors were incubated in a water temperature bath maintained at 23 °C using an automatic temperature controller. The oxygen uptake by any bacteria growing in the reactors was monitored continuously and reported at 2 hour intervals.

As illustrated in Figure 2, carpet fiber which had not been inoculated with the bacterial spore blend demonstrated only a very slight increase in oxygen uptake after about 24 hours of incubation. The oxygen uptake did not increase above this level up to 60 hours post-inoculation. These results indicate minimal bacterial growth in the control carpet sample. In contrast, the carpet fiber inoculated with the bacterial spore blend showed an increase in oxygen uptake starting 22 to 24 hours after inoculation. This increase in oxygen uptake continued up to the end of the test at 60 hours post-incubation with the oxygen intake increasing in a steady linear fashion with no leveling off of the uptake seen during the 60 hours of the test. These results indicate that the dormant bacteria are capable of germinating to

become active and undergo growth in response to exposure to a suitable food source.

Example 3

To confirm that the bacterial spore blend utilized in the present invention could grow on various organic soils, plates containing materials representative of common household or soil causing organic based materials were inoculated with the bacterial spore blend. The organic based materials utilized were chocolate syrup, tomato sauce, milk, dog feces and fox urine. The growth on these soils was compared to a standard plate count broth utilized for counting colony forming units. The plates were inoculated with dilutions of the bacterial spore blend to give between about 300 and 400 spores per plate and incubated at 37°C and 50% humidity. At two days and four days post inoculation, the colony forming units (CFU) were counted and the CFU's per ml of the innoculum were calculated. After two days, the bacterial preparations were growing well on the tomato sauce, chocolate syrup and dog feces, with growth almost at the level of the standard plate count broth. A minimal increase in growth on the autoclaved milk or fox urine was observed after two days, although there was some growth. After four days, the growth on all five materials was comparable, being only slightly less than the growth on the plate count broth. These results indicate that the bacterial spore blend can grow well on common organic soil, such as chocolate syrup, tomato sauce, dog feces and fox urine.

Example 4

The bacterial spore blend was tested using respirometric studies as set out in Example 2 above to confirm that it could utilize pet waste for growth in carpets. Samples of the carpet fiber were examined for oxygen uptake using a standard respirometric study conducted using a Challenge AER100 respirometer with all samples incubated under controlled temperature conditions.

The treatment reactors were 500 ml bottles. The CO_2 adsorption trap inserts contained 5 ml of 30% KOH (w/v) with alizarin yellow pH indicator. The sterilized traps were filled with the KOH caustic solution then insert d into the sterilized reactors using aseptic techniques. The CO_2 traps also contained sterilized medical cotton rolls used as wicks to increase the surface area of the caustic solution. Each reactor was provided with sufficient carpet material to yield 5 grams of carpet fiber. The organic material (i.e. dog feces, fox urine, plate count broth, etc.) was added to the reactor and the reactors autoclaved to sterilize them. The reactors were allowed to cool and 0.5 ml of the bacterial suspension containing 10^8 spores per ml were added to the test reactors. The same volume of distilled water was added to the control reactors. The reactors were capped without the caustic traps and rolled and swirled to ensure that the water and bacterial preparations were mixed well with the organic materials and to permit the carpet to absorb the liquid. The caustic traps were then inserted into the reactors and the reactors hooked up to the respirometer systems. The reactors were incubated in a water temperature bath maintained at 23 °C using an automatic temperature controller. The oxygen uptake in the reactors was monitored continuously and reported at 2 hour intervals.

The carpet sample in the control reactor with no innoculum did not have any significant increase in oxygen uptake over the 96 hours of the test. The carpet samples which had been inoculated with the bacterial spore blend started showing an increase in oxygen uptake after 32 hours post-inoculation. This increase in oxygen uptake continued to the end of the test in a linear fashion with no plateauing of the oxygen uptake observed up to 96 hours post-inoculation. This clearly shows that the bacterial spore blend associated with the carpet can become activated and undergo growth when exposed to a common organic spill material.

The compositions and method of the present invention provide for effective odor control for carpet. The use of the bacterial preparations, particularly the sporulated forms of Bacillus, provide for control of odor caused by deposits of organic odor causing material on carpets and other fibrous material. Once the deposit comes into contact with the bacteria, the bacteria germinate if in the dormant form, and commence growing by feeding on the organic material as a food source. As can be observed from the above experiments with the sporulated Bacillus, this bacterial growth commences within about 24 and 48 hours after the bacteria encounter the deposit. In some circumstances, it may be desirable to mask the odor using odor masking agents until the sporulated bacteria can germinate, grow and effectively decompose the odor causing agents. Alternatively, the bacterial preparations may include suitable protease and lipase enzymes to commence the digestion of the odor causing material until the bacteria commence their growth stage and can take over the digestion of the odor causing material. As a further alternative, introducing suitable molecular sieves that can quickly bind the offensive odor within its' poors, allowing time for the sporulated bacteria to decompose the odor causing material.

It has surprisingly been found that the odor control agent applied to the carpet as described above remains effective for extended periods of time even with carpet exposed to high traffic and repeated vacuuming. The exact mechanism for this is not completely understood, but it is suspected that the dormant bacteria become so tightly associated with the carpet fibers that they are not easily removed when exposed to traffic or vacuuming. The use of the stain blocker and/or fluorochemical in the aqueous solution used in the application of the agent to the carpet is suspected to increase the association of the dormant bacteria with the carpet fibers, and hence increase the

effective life of the treatment. It is suspected that the treatment may also remain after wet cleaning of the carpet. However, it is suggested that the carpet be treated with the odor controlling bacterial preparation on a routine basis such as after each wet cleaning. This can be easily accomplished after cleaning with the preparation applied to the carpet either when still wet from the cleaning or after the carpet has dried. Preferably, the preparation is applied to the carpet while still wet, worked into the carpet with a pile brush and the carpet is allowed to dry naturally.

In addition to providing for removal of potentially odor causing organic material associated with deposits on carpet and other fibrous material, the use of the bacterial preparations of the present invention provides other benefits. Based upon the observations from the electron micrographs, it is expected that the presence of the bacterial preparation in association with the carpet fiber and other fibrous material may result in a reduction in the presence of other bacteria and organisms which are naturally found on installed carpet and other fibrous material, both in number and population. It has also been found that the bacterial preparation associated with the carpet fiber or other fibrous material enhances the anti-stain characteristics of the carpet. Many of the stain causing materials are organic in nature and it has been found that the bacteria can utilize such organic materials as a food source. As the stain causing material is consumed by the bacteria, the staining properties of the compounds are reduced.

The method and compositions of the present invention are especially suitable for use with carpet as described in the specific examples set out above. These methods and compositions are also suitable for use with other fibrous material which may be susceptible to the effects of deposits of organic material. Examples of such

other fibrous materials include rugs, upholstery fabrics, automotive fabrics, bedding, clothing, etc. Suitable binders may be determined to improve the longevity and efficacy to address wash and wearing performance. Other applications may include hard surfaces, such as ceramics, tile, walls, wood, etc.

Although various preferred embodiments of the present invention have been described herein in detail, it will be appreciated by those skilled in the art, that variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method for controlling odor associated with deposits of organic material which can cause odors on carpets or other fibrous material, the method comprising applying to the carpet or other fibrous material or to the fibers used in the manufacture of the carpet or other fibrous material, a preparation of dormant bacteria, which when activated are effective to control odors, the dormant bacterial preparation being allowed to become associated with the carpet or other fibrous material such that when the carpet or other fibrous material is exposed to organic material which can cause odors, the bacteria are capable of becoming active and digesting the organic material.

2. A method as claimed in claim 1 wherein the dormant bacteria are sporulated forms of one or more strains selected from the bacterial genera Bacillus.

3. A method as claimed in claim 1 wherein the dormant bacteria are sporulated forms of one or more strains selected from the group of bacterial species consisting essentially of Bacillus licheniformis, Bacillus pasteurii, Bacillus laevolacticus and Bacillus amyloliquefaciens.

4. A method as claimed in claim 3 wherein the dormant bacteria are applied to the carpet at a concentration of between about 10^6 and about 10^8 cells per gram of carpet fiber.

5. A method as claimed in claim 4 wherein the dormant bacteria are applied to the carpet at a concentration of about 10^7 cells per gram of carpet fiber.

composition comprising one or more stain-blocker chemicals and an effective amount of odor controlling bacteria.

13. An aqueous odor controlling bacterial composition as claimed in claim 12 wherein the bacteria are one or more strains selected from the group of bacterial genera consisting of Bacillus, Enterobacter, Streptococcus, Nitrosomonas, Nitrobacter, Pseudomonas, Alcaligens and Klebsiella.

14. An aqueous odor controlling bacterial composition as claimed in claim 13 wherein the bacteria are one or more strains selected from the group of bacterial species consisting essentially of Bacillus licheniformis, Bacillus pasteurii, Bacillus laevolacticus and Bacillus amyloliquefaciens.

15. An aqueous odor controlling bacterial composition as claimed in claim 14 wherein the bacteria are applied to the carpet or other fibrous material at a concentration of between about 10^6 and about 10^8 cells per gram of carpet fiber.

16. An aqueous odor controlling bacterial composition as claimed in claim 15 wherein the dormant bacteria are applied to the carpet or other fibrous material at a concentration of about 10^7 cells per gram of carpet fiber.

17. An aqueous odor controlling bacterial composition as claimed in claim 14 wherein the bacterial preparation comprises:

	% of total bacteria	
Species	Range	Preferred
Bacillus licheniformis	20-60	40
Bacillus pasteurii	10-30	20
Bacillus laevolacticus	10-30	20
Bacillus amyloliquefaciens	10-30	20

18. An aqueous odor controlling bacterial composition as claimed in claim 14 wherein the one or more stain-blocking chemicals are selected from the group consisting of sulfonated phenol formaldehyde condensate polymer, sulfonated naphthol formaldehyde condensate polymer, and hydrolyzed vinyl aromatic maleic anhydride polymer.

19. An aqueous odor controlling bacterial composition as claimed in claim 18 wherein the preparation contains an amount of the stain blocker to result in a treat rate of the carpet of about 0.1 wt% to about 20 wt% based upon the weight of the carpet fiber.

20. An aqueous odor controlling bacterial composition as claimed in claim 19 wherein the treat rate is from about 0.25 wt% to about 20 wt%.

21. An aqueous odor controlling bacterial composition as claimed in claim 20 wherein the bacterial composition further includes one or more anti-soil fluorochemicals.

22. A carpet capable of controlling odor associated with deposits of organic material which can cause odors on the carpet, the carpet comprising fibers tufted through a primary backing, the fibers having associated therewith a preparation of dormant bacteria, which when activated are effective to control odors, such that when the carpet is exposed to organic material which can cause odors, the bacteria are capable of becoming active and digesting the organic material.

23. A carpet as claimed in claim 23 wherein the bacteria are one or more strains selected from the group of bacterial genera Bacillus.

24. A carpet as claimed in claim 22 wherein the bacteria are one or more strains selected from the group of bacterial species consisting essentially of Bacillus

licheniformis, Bacillus pasteurii, Bacillus laevolacticus and Bacillus amyloliquefaciens.

25. A carpet as claimed in claim 24 wherein the dormant bacteria are applied to the carpet at a concentration of between about 10^6 and about 10^8 cells per gram of carpet fiber.

26. A carpet as claimed in claim 25 wherein the dormant bacteria are applied to the carpet at a concentration of about 10^7 cells per gram of carpet fiber.

27. A carpet as claimed in claim 24 wherein the dormant bacterial preparation comprises:

	% of total bacteria	
Species	Range	Preferred
Bacillus licheniformis	20-60	40
Bacillus pasteurii	10-30	20
Bacillus laevolacticus	10-30	20
Bacillus amyloliquefaciens	10-30	20

28. A carpet as claimed in claim 24 wherein the carpet has also been treated with one or more stain-blocking chemicals.

29. A carpet as claimed in claim 28 wherein the one or more stain-blocking chemicals are selected from the group consisting of sulfonated phenol formaldehyde condensate polymer, sulfonated naphthol formaldehyde condensate polymer, and hydrolyzed vinyl aromatic maleic anhydride polymer.

30. A carpet as claimed in claim 29 wherein the preparation contains an amount of the stain blocker to result in a treat rate of the carpet of about 0.1 wt% to about 20 wt% based upon the weight of the carpet fiber.

31. A carpet as claimed in claim 30 wherein the treat rate is from about 0.25 wt% to about 20 wt%.

32. A carpet as claimed in claim 29 wherein the carpet has also been treated with one or more anti-soil fluorochemicals.

Figure 1A
Scanning Electronic Microscopic
- No Bacteria Added

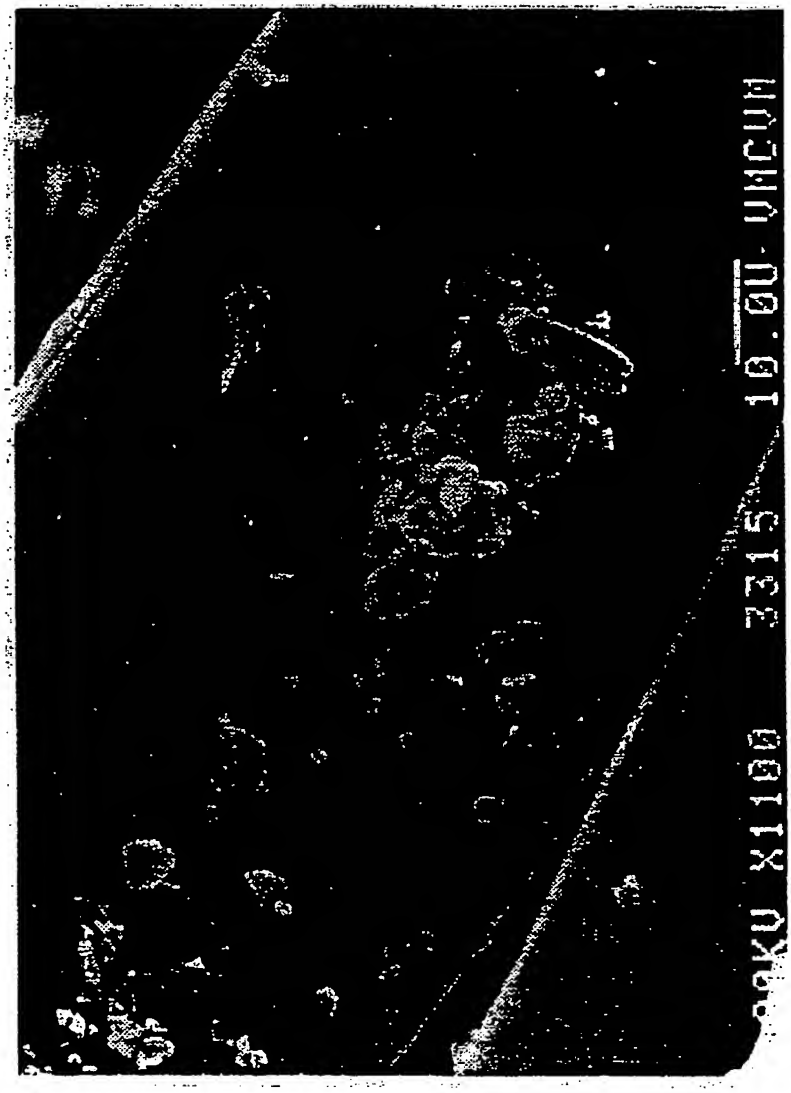
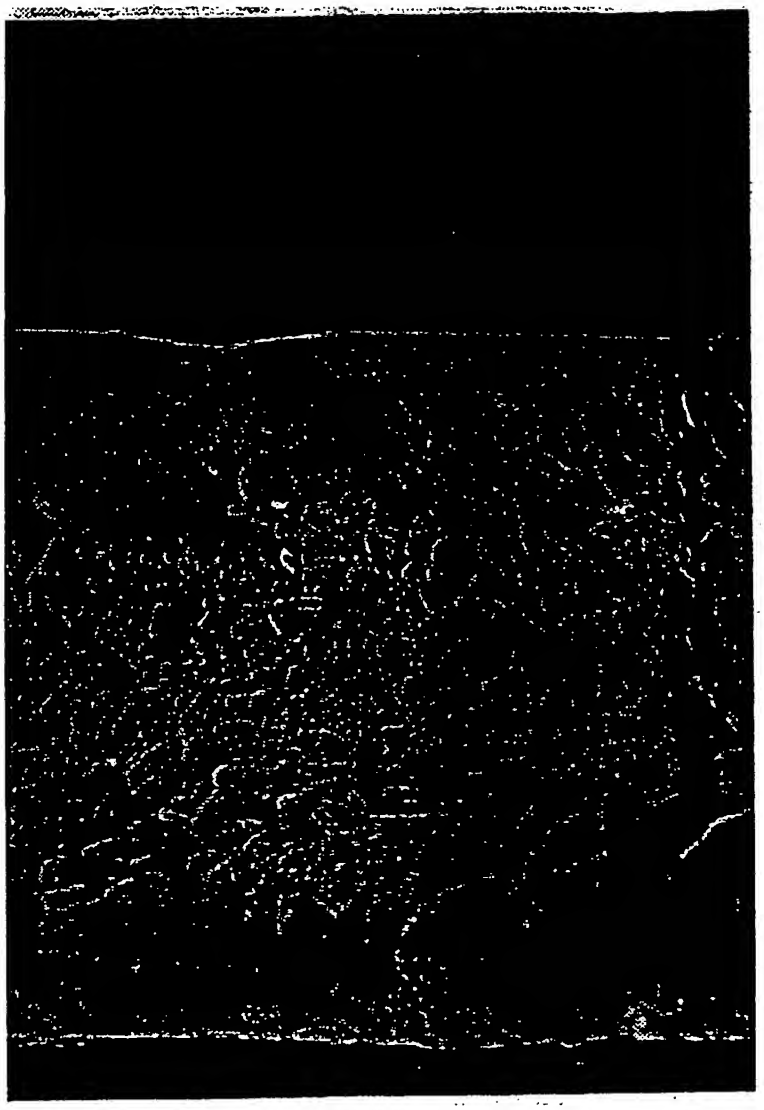


Figure 1B
Scanning Electronic Microscopic Results
Fiber with Bacteria Spore Blend



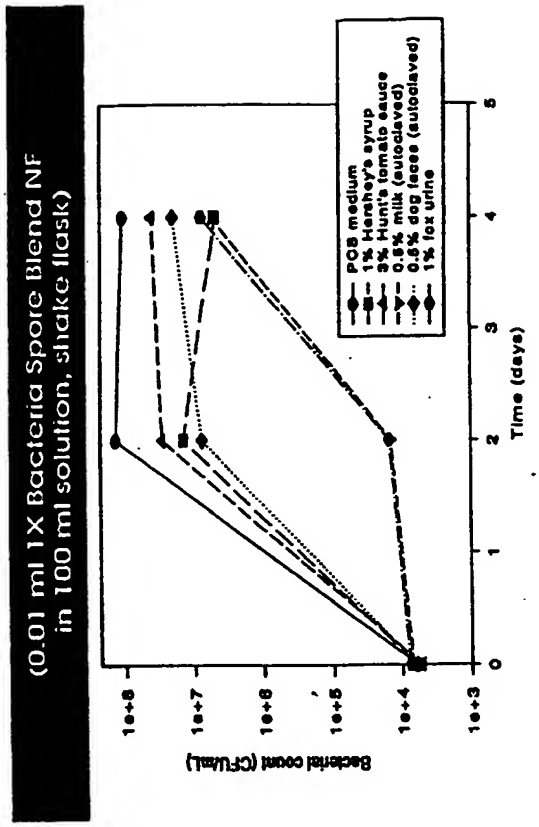

(0.01 ml 1X Bacteria Spore Blend NF in 100 ml solution, shake flask)
POB medium
1% Hershey's syrup
5% Hunt's tomato sauce
0.5% milk (autoclaved)
0.5% dog feces (autoclaved)
1% fox urine
Bacterial count (CFU/mL)
1e+8
1e+7
1e+6
1e+5
1e+4
1e+3
Time (days)
0
1
2
3
4
5

Figure 2

(Respirometric study results: ca. 100% moisture, ca. 10^4 CFU/g inoculum)

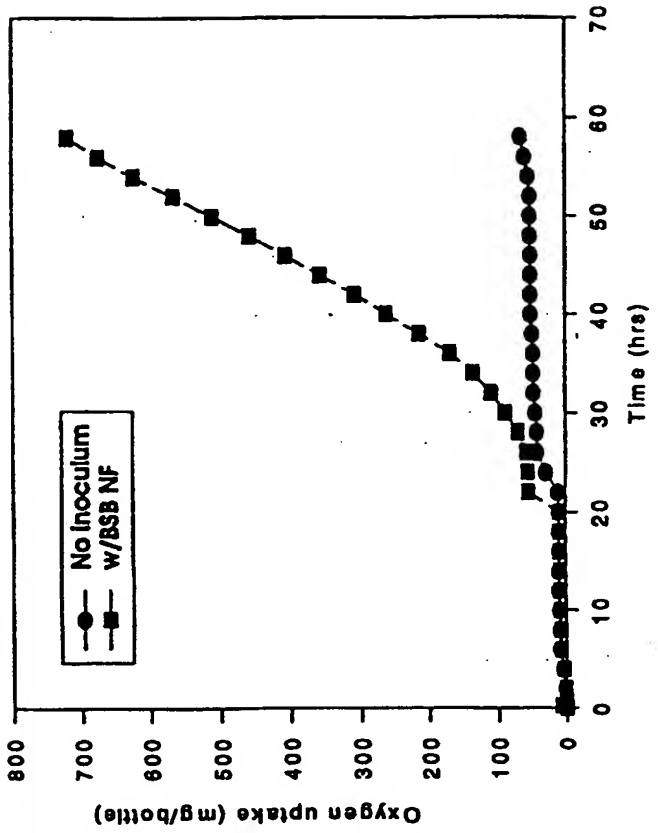


Figure 3

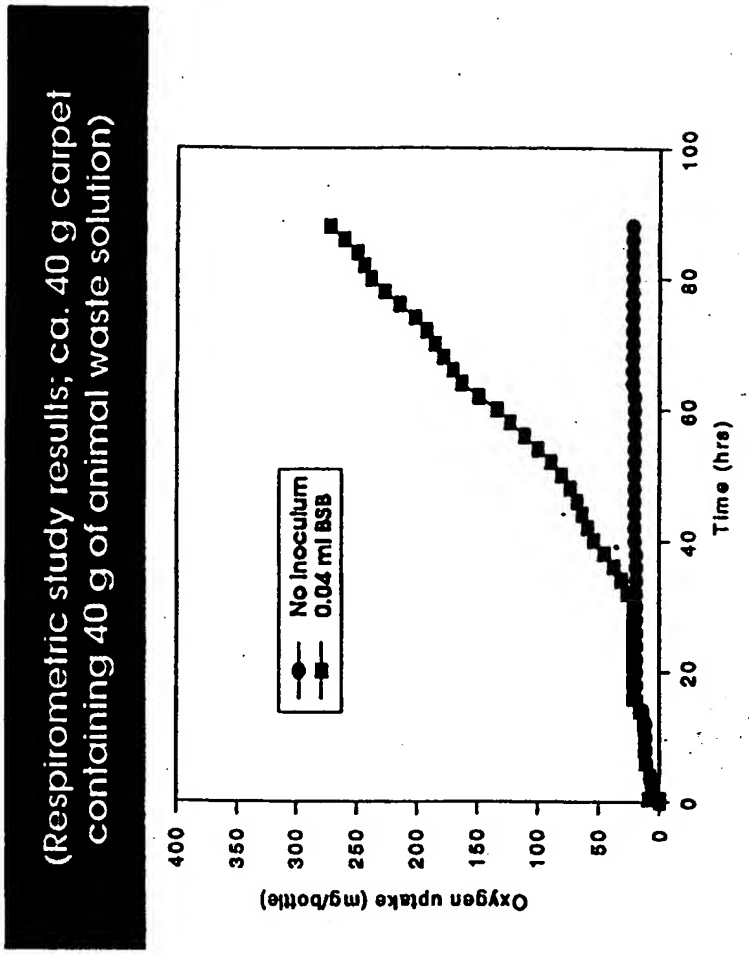

(Respirometric study results; ca. 40 g carpet containing 40 g of animal waste solution)
Oxygen uptake (mg/bottle)
400
350
300
250
200
150
100
50
0
0
20
40
60
80
100
Time (hrs)
No inoculum
0.04 ml BSB

Figure 4

INTERNATIONAL SEARCH REPORT

International Application No
. .T/CA 99/00628

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61L9/01 D06M16/00 D06M15/41 D06M15/233 D06M15/263
//A61L101:52

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 D06M A61L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CHEMICAL ABSTRACTS, vol. 108, no. 20, May 1998 (1998-05) Columbus, Ohio, US; abstract no. 169120y, XP002122802 & CS 246 119 A (DOSTAL JAROSLAV; VIEST MIROSLAV) 16 October 1986 (1986-10-16) abstract	1,3,7,8, 11,12, 18,22
Y	US 4 925 707 A (VINOD YASHAVANT V) 15 May 1990 (1990-05-15) cited in the application abstract column 1, line 6-11 column 3, line 52-58 claims 1,19,24,25,29	1,3,7,8, 11,12, 18,22

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 November 1999	26/11/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Böhm, I

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 99/00628

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 96 19611 A (HEINE ELISABETH ;HOECKER HARTWIG (DE); DYBDAL LONE (DK); NOVONORDI) 27 June 1996 (1996-06-27) page 15, line 14-31	1-3, 12-14, 23,24
A	US 4 680 212 A (BLYTH RANDOLPH C ET AL) 14 July 1987 (1987-07-14) cited in the application abstract column 1, line 15-30 column 2, line 28-65 column 3, line 27-66 column 4, line 10-64	1,3,7,8
A	DATABASE WPI Section Ch, Week 199715 Derwent Publications Ltd., London, GB; Class A97, AN 1997-159089 XP002122803 & JP 09 028377 A (AZUMA K), 4 February 1997 (1997-02-04) abstract	1,12,22

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/CA 99/00628

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
CS 246119	A	16-10-1986	NONE		
US 4925707	A	15-05-1990	AU	2709088 A	22-06-1989
			BE	1004111 A	29-09-1992
			DE	3842989 A	29-06-1989
			FR	2624895 A	23-06-1989
			GB	2211865 A,B	12-07-1989
			IT	1228102 B	28-05-1991
			JP	2004305 A	09-01-1990
			JP	2717216 B	18-02-1998
			US	5059420 A	22-10-1991
			US	5137759 A	11-08-1992
			US	5096747 A	17-03-1992
WO 9619611	A	27-06-1996	AU	4298696 A	10-07-1996
			BR	9510216 A	04-11-1997
			CN	1170448 A	14-01-1998
			EP	0799344 A	08-10-1997
			HU	77196 A	02-03-1998
			JP	10511437 T	04-11-1998
			PL	321426 A	08-12-1997
			TR	960604 A	21-07-1996
US 4680212	A	14-07-1987	US	5182154 A	26-01-1993
			EP	0242496 A	28-10-1987
			US	4839212 A	13-06-1989
			US	4879180 A	07-11-1989
			US	4892558 A	09-01-1990
			US	RE33365 E	02-10-1990
JP 9028377	A	04-02-1997	NONE		